CLAIMS:

1. An apparatus for optical modulation, the apparatus comprising:

an optical waveguide (10); and

a microwave waveguide (12), said microwave waveguide (12) having an electro-absorptive material (14) sized and placed such that, for an optical wave of interest guided in said optical waveguide (10), the electro-absorptive material (14) is located in an evanescent region (16) occupied by the optical wave's evanescent tail when the optical wave is being guided in said optical waveguide (10).

2. The apparatus recited in claim 1, wherein

said optical waveguide (10) includes

a substrate (18);

an N-contact layer (26);

an upper semiconducting cladding layer (20) disposed between said substrate (18) and said N-contact layer 20;

a semiconducting core layer (22) disposed between said substrate (18) and said upper semiconducting cladding layer (20); and

a lower semiconducting cladding layer (24) disposed between said substrate (18) and said semiconducting core layer (22); and

wherein N-contact layer (26) and an upper part of upper semiconducting cladding layer (20) are etched down to form a ridge.

3. The apparatus recited in claim 2, wherein

said microwave waveguide (12) includes

two N-contacts (28) disposed on said N-contact layer (26);

said electro-absorptive material is disposed between and equidistant from said N-contacts (28) on said ridge of said upper

semiconducting cladding layer (20);

a P-contact layer (30) disposed on said EA material (14); and

a P-contact (32) disposed on said P-contact layer (30).

4. The apparatus recited in claim 3, wherein

said N-contacts (28) are disposed at each outer edge of said ridge of said N-contact layer (26).

5. The apparatus recited in claim 2, wherein

said microwave waveguide (12) includes

two N-contacts (28) disposed on said N-contact layer (26), each of said N-contacts (28) being disposed on either side of a main mode region (34) and said evanescent region (16) of said optical waveguide (10), wherein said N-contact layer (26) and said upper semiconducting cladding layer (20) have an etched-away area between each of said N-contacts (28) and said main mode region (34) and said evanescent region (16) of optical waveguide (10) to form a ridge;

said electro-absorptive material (14) disposed on said N-contact layer (26) on said ridge;

a P-contact layer (32) disposed on said electro-absorptive material (14) on either side of a top surface of said electro-absorptive material (14);

two insulators (35) disposed on said N-contact layer (20) in contact with side surfaces of said electro-absorptive material (14), wherein each of said insulators (35) is in contact with said P-contact layer (32), and wherein said P-contact layer (32) and said insulators (35) form an inverted V-shaped groove with a truncated tip at said top surface of said electro-absorptive material (14); and

a P-contact (36) disposed in said V-shaped groove and extending at least to a top surface of each of said insulators (35).

6. The apparatus recited in claim 5, wherein

said N-contacts (26) are disposed at each edge of said etched-away areas opposite said ridge formed by said etched-away areas.

7. The apparatus recited in claim 5, wherein said apparatus

has a microwave modulation voltage less than or equal to 0.3 V,

has an optical saturation power of equal to or greater than 100mW,

has an operating bandwidth equal to or greater than 40 GHz,

has an effective thickness of EA material (14), $d_{i,eff}$, less than or equal to 0.1 μm, and

has a microwave propagation loss per unit length, α_{rf}, less than or equal to 3 dB/mm;

is capable of having a microwave wave guide in microwave waveguide (12) and an optical wave guided in optical waveguide (10) wherein a phase velocity of the microwave wave and a phase velocity of the optical wave are equal; and

microwave waveguide (12) has an impedance capable of being matched to a microwave driver, the microwave driver being capable of supply a microwave wave to be guided in said microwave waveguide (12).

8. The apparatus recited in claim 1, wherein

said electro-absorptive material (14) is a multiple quantum well material.

9. The apparatus recited in claim 1, wherein said electro-absorptive material (14) is a Franz-Keldysh material.

10. The apparatus recited in claim 1, wherein said electro-absorptive material (14) is a group III-V compound material.

11. The apparatus recited in claim 1, wherein said electro-absorptive material (14) is InGaAsP.

12. The apparatus recited in claim 1, wherein said electro-absorptive material (14) is GaInAlAs.

13. A method for optical modulation, said method comprising the steps of:

guiding an optical wave in an optical waveguide (10), said optical wave having an evanescent tail; and

applying a modulation voltage to said evanescent tail.

14. The method recited in claim 13, further comprising a step of:

positioning an electro-absorptive material (14) in said evanescent tail of said optical wave; and

wherein said step of applying a modulation voltage to said evanescent tail is performed by applying said modulation voltage to said electro-absorptive material (14).

15. The method recited in claim 13, wherein said modulation voltage is analog.

16. The method recited in claim 13, wherein said modulation voltage is digital.

17. The method recited in claim 13, wherein said step of guiding said optical wave includes direct coupling a single mode fiber optical wave into said optical waveguide (10).

18. The method recited in claim 13, wherein an optical confinement factor of said electro-absorption material (14), Γ, between and 1% and 5% enables the optical modulation of an optical power equal to or greater than 100 mW.